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## ZX Spectrum



# Sinclair ZX Spectrum-technical data.

### Dimensions

Width 233 mm  
Depth 144 mm  
Height 30 mm

### CPU memory

Z80A microprocessor running at 3.5 MHz.  
16K-byte ROM containing BASIC interpreter and operating system.

16K-byte RAM (plus optional 32K-byte RAM on internal expansion board) or 48K-byte RAM.

### Keyboard

40-moving-key keyboard with full upper and lower case with capitals lock feature. All BASIC words obtained by single keys, plus 16 graphics characters, 22 colour control codes, and 21 user-definable graphics characters. All keys have auto-repeat.

### Display

Memory-mapped display of 256 pixels x 192 pixels plus one attributes byte per character square, defining one of eight foreground colours, one of eight background colours, normal or extra brightness and flashing or steady. Screen border colour is also settable to one of eight colours. Will drive a PAL UHF colour TV set, or black and white set (which will give a scale of grey), on channel 36.

### Sound

Internal loudspeaker can be operated over more than 10 octaves (actually 130 semitones) via basic BEEP command. Jack sockets at the rear of computer allow connections to external amplifier/speaker.

### Graphics

Point, line, circle and arc drawing commands in high-resolution graphics. 36 pre-defined graphics characters plus 21 user-definable graphics characters. Also functions to yield character at a given position, attribute at a given position (colours, brightness and flash) and whether a given pixel is set. Text may be written on the screen on 24 lines of 32 characters. Text and graphics may be freely mixed.

### Colours

Foreground and background colours, brightness and flashing are set by BASIC INK, PAPER, BRIGHT and FLASH commands. OVER may also be set, which performs an exclusive-or operation to overwrite any printing or plotting that is already on the screen. INVERSE will give inverse video printing. These six commands may be set globally to cover all further PRINT, PLOT, DRAW or CIRCLE commands, or locally within these commands to cover only the results of that command. They may also be set locally to cover text printed by an INPUT statement. Colour-control codes, which may be accessed from the keyboard, may be inserted into text or program listing, and when displayed will override the globally set colours until another control code is encountered. Brightness and flashing codes may be inserted into program or text; similarly, colour-control codes in a program listing have no effect on its execution. Border colour is set by a BORDER command. The eight colours available are black, blue, red,

green, cyan, yellow and white. All eight colours may be present on the screen at once, with some areas flashing and others steady, and any area may be highlighted extra bright.

### Screen

The screen is divided into two sections. The top section - normally the first 22 lines - displays the program listing or the results of program or command execution. The bottom section - normally the last 2 lines - shows the command or program line currently being entered, or the program line currently being edited. It also shows the report messages. Full editing facilities of cursor left, cursor right, insert and delete (with auto-repeat facility) are available over this line. The bottom section will expand to accept a current line of up to 22 lines.

### Mathematical operations and functions

Arithmetic operations of +, - X, ÷, and raise to a power. Mathematical functions of sine, cosine, tangent and their inverses; natural logs and exponentials; sign function, absolute value function, and integer function; square root function, random number generator, and pi.

Numbers are stored as five bytes of floating point binary - giving a range of  $+3 \times 10^{-30}$  to  $+7 \times 10^{30}$  accurate to 9 decimal digits.

Binary numbers may be entered directly with the BIN function. =, <, >, <=, >= and <> may be used to compare string or arithmetic values or variables to yield 0 (false) or 1 (true). Logical operators AND, OR and NOT yield boolean results but will accept 0 (false) and any number (true).

User-definable functions are defined using DEF FN, and called using FN. They may take up to 26 numeric and 26 string arguments, and may yield string or numeric results.

There is a full DATA mechanism, using the commands READ, DATA and RESTORE.

A real-time clock is obtainable.

### String operations and functions

Strings can be concatenated with +. String variables or values may be compared with =, <, >, <=, >= to give boolean results. String functions are VAL, VAL\$, STR\$, LEN, CHR\$ and CODE convert numbers to characters and vice versa, using the ASCII code.

A very powerful string slicing mechanism exists, using the form a\$ (x TO y).

### Variable names

Numeric - any string starting with a letter (upper and lower case are not distinguished between, and spaces are ignored).

String - A\$ to Z\$.

FOR-NEXT loops - A-Z.

Numeric arrays - A-Z.

String arrays - A\$ to Z\$.

Simple variables and arrays with the same name are allowed and distinguished between.

### Arrays

Arrays may be multi-dimensional, with subscripts starting at 1. String arrays, technically character arrays, may have their last subscript omitted, yielding a string.

### Expression evaluator

A full expression evaluator is called during program execution whenever an expression, constant or variable is encountered. This allows the use of expressions as arguments to GOTO, GOSUB, etc.

It also operates on commands allowing the ZX Spectrum to operate as a calculator.

### Cassette interface

The ZX Spectrum incorporates an advanced cassette interface. A tone leader is recorded before the information to overcome the automatic recording level fluctuations of some tape recorders, and a Schmitt trigger is used to remove noise on playback.

All saved information is started with a header containing information as to its type, file length and address information. Program, screens, blocks of memory, string and character arrays may all be saved separately.

Programs, blocks of memory and arrays may be verified after saving to confirm successful saving.

Programs and arrays may be merged from tape to combine them with the existing contents of memory. Where two line numbers or variables coincide, the old one is overwritten.

Programs may be saved with a line number, where execution will start immediately on loading. The cassette interface runs at 1500 baud, through two 3.5 mm jack plugs.

### Expansion port

This has the full data, address and control busses from the Z80A, and is used to interface to the ZX Printer, the RS232 and NET interfaces and the ZX Microdrives.

IN and OUT commands give the I/O port equivalents of PEEK and POKE.

### ZX81 compatibility

ZX81 BASIC is essentially a subset of ZX Spectrum BASIC. The differences are as follows:

**FAST and SLOW:** the ZX Spectrum operates at the speed of the ZX81 in FAST mode with the steady display of SLOW mode, and does not include these commands.

**SCROLL:** the ZX Spectrum scrolls automatically, asking the operator "scroll?" every time a screen is filled.

**UNPLOT:** the ZX Spectrum can unplot a pixel using PLOT OVER, and thus achieves unplot.

**Character set:** the ZX Spectrum uses the ASCII character set, as opposed to the ZX81 non-standard set.

**ZX81 programs** may be typed into the ZX Spectrum with very little change, but may of course now be considerably improved. The ZX Spectrum is fully compatible with the ZX Printer, which can now print out a full upper and lower case character set, and the high resolution graphics, using LLIST, LPRINT and COPY. ZX81 software cassettes and the ZX 16K RAM pack will not operate with the ZX Spectrum.

Available from:

**Sinclair**  
**ZX Spectrum**

Sinclair Research Ltd, Stanhope Road, Camberley,  
Surrey, GU15 3PS. Tel: Camberley (0276) 685311.

# ZX Spectrum

*the 16K computer  
with colour graphics,  
for under £100!*

**Sinclair, the first to offer affordable computer power.**

Sinclair's ZX80 was the first-ever personal computer to cost under £100. It was followed by the ZX81 and the ZX Printer. Today, over 850,000 of those products are in use.

Then came the Sinclair ZX Spectrum, the ultimate in a line of proven personal computers. With vivid colour, advanced high-resolution graphics, sound, 16K or a massive 48K RAM, it was unique.

The ZX Spectrum set a standard for personal computers which has yet to be equalled. And at its launch price of £125, it set a standard for value that was unrivalled.

But now, the ZX Spectrum is more affordable than ever before ...

## While others promise, Sinclair deliver.

Every personal computer manufacturer talks of breaking the £100 barrier to quality colour graphics.

We've done it.

How? By taking advantage of the economies of ever-increasing volume production. Already we've sold more than 300,000 ZX Spectrums (one in every two personal computer purchases is a Sinclair purchase). Unit production costs have dropped, dramatically.

Why bother to reduce the already low price of Sinclair computers? Because, simply, we hope you'll choose Sinclair, now. Rather than wait for other manufacturers to keep their promises.

## More power for your pound.

With its 16K BASIC ROM, the ZX Spectrum offers truly generous computing capability.

You have a choice of 8 colours for foreground, background, border, characters and symbols, together with sound generation and high-resolution graphics.

You've a choice of storage capacities, either an ample 16K, or a massive 48K RAM.

You may decide to begin with the 16K model. Later, you can return it to us for a simple upgrade to the full 48K (details with every Spectrum).

## The expandable system, committed to long life.

The price of your Spectrum includes everything you need to begin computing, the same day. It comes with every necessary connection for power, cassette recorder and TV.

You get two manuals which form, if you require it, a complete and detailed course in Sinclair BASIC programming (used now in more than 1.5 million computers worldwide).

Whether you're a complete beginner, or an experienced programmer, you'll find the manuals of great value. Depending on your computer experience, you'll move quickly into the colourful world of ZX Spectrum professional-level computing.

But how far you go with the Spectrum is up to you. For it's just the heart of a fully expandable system, which you can build in easy stages. The first of those system additions is already here: the ZX Printer. And it, too, has been around long enough for its price to drop to just £39.95!

When you buy a Spectrum, you buy a personal computer that's packed with long-term potential. And you'll buy it with the assurance that it's not about to be superseded. Certainly not by Sinclair, probably not by any other computer, for a long time to come.

You've a choice of storage capacities, either an ample 16K, or a massive 48K RAM.

You may decide to begin with the

16K model. Later, you can return it to us

for a simple upgrade to the full 48K

(details with every Spectrum).

A special feature is COPY which

prints out exactly what is on the whole TV

screen without the need for further

instructions. Printing speed is 50

characters per second, with 32 characters

per line and 9 lines per vertical inch.

The ZX Printer connects to the rear

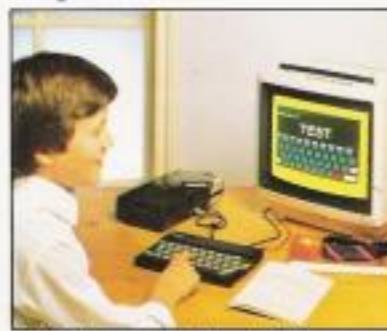
of your ZX Spectrum. A roll of paper

(65 ft long and 4 in wide) is supplied,

along with full instructions. Further

supplies of paper are available in packs

of five rolls.



ZX Spectrum, a valuable learning tool ...



## Choose your software from a huge and growing range.

As the Spectrum library of ready-made programs grows, so the need to write your own programs decreases. Each new program allows you to exploit the power of your Spectrum in a new way, quickly and easily.

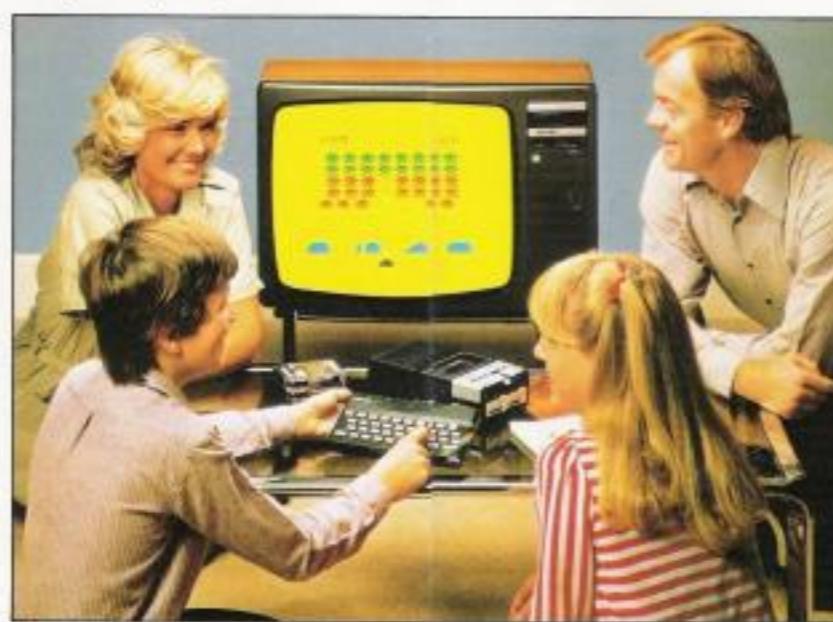
Currently, the library lists over 50 specially written programs. Subjects range from challenging adventures and addictive games, to educational topics and business programs; from accounts to household management systems.

And nowhere has the potential of a microcomputer been so brilliantly demonstrated as in VU-3D, a three-dimensional graphics program, or Flight Simulation. The full Spectrum software range is too long — and too fast-growing — to list here. You'll receive a detailed catalogue with your Spectrum.



An expanding range of tailor-made software, to help you make the most of your ZX Spectrum, fast.

**16K - now £99.95**  
**48K - now £129.95**  
**ZX Printer - now £39.95**



... and a friend of the family.



What the screen shows, the ZX Printer records. Just plug in and print, for under £39.95!

Designed exclusively for use with the Sinclair ZX range of computers, the printer offers ZX Spectrum owners the full ASCII character set — including lower-case characters and high-resolution graphics.

A special feature is COPY which prints out exactly what is on the whole TV screen without the need for further

## Key features of the Sinclair ZX Spectrum.

- Full colour — 8 colours each for foreground, background and border, plus flashing and brightness-intensity control.
- Sound — BEEP command with variable pitch and duration.
- Massive RAM — 16K or 48K.
- Full-size moving-key keyboard — all keys at normal typewriter pitch, with repeat facility on each key.
- High-resolution — 256 dots horizontally x 192 vertically, each individually addressable for true high-resolution graphics.
- ASCII character set — with upper- and lower-case characters.
- Teletext-compatible — user software can generate 40 characters per line or other settings.
- High speed LOAD & SAVE — 16K in 100 seconds via cassette, with VERIFY & MERGE for programs and separate data files.
- Sinclair 16K extended BASIC — incorporating unique 'one-touch' keyword entry, syntax, check, and report codes.

instructions. Printing speed is 50 characters per second, with 32 characters per line and 9 lines per vertical inch.

The ZX Printer connects to the rear of your ZX Spectrum. A roll of paper (65 ft long and 4 in wide) is supplied, along with full instructions. Further supplies of paper are available in packs of five rolls.